THE TELEGRAPHIC JOURNAL.
VOL. V.—No. 97.

TELEGRAPH REFORM IN GERMANY.

PREVIOUSLY to the telegraphic reform which an ordinance of the Chancellor of the Empire introduced into Germany in March last, the home tariffs had for base, like those of the international service, the simple telegram of twenty words, with progression of half by indivisible series of ten words, and it included three zones, to which the following charges applied:—

First zone (maximum of direct distance 18 geographical miles = 135 kilom.) 5 silber groschen or 50 pfennig = about 6d.

Second zone (maximum of direct distance 52 geographical miles = 390 kilom.) 10 silber groschen or 1 mark = about 1s.

Third zone (distances beyond) 15 silber groschen = about 1s. 6d.

After the first of March the charge became uniform for the whole telegraphic territory of the empire, and it consisted:—

1. Of a fixed charge of 20 pfennig (say 2d.) applicable to each telegram, independently of the number of words. 2. Of a proportional charge of 5 pfennig (say ½d.) per word, without condition of a minimum of words.

As will be seen, the reform had a double object; in the first place, the adoption of a new unit, that of the word replacing the old unit of twenty words; and in the second place, the substitution of a single charge for the three charges of the old division of zones. Independently, then, of the general effect produced on the whole of the traffic by the change of unit of charge, this was calculated to produce a particular and different effect on the special telegraph traffic of each zone. To obtain, indeed, with the new system of a single charge, the old conditions of the minimum charge for twenty words, the sender must in the first zone limit the extent of his telegram to six words, while in the second he may raise it to sixteen, and in the third to twenty. If the adoption of a single charge had not been accompanied by that of the word unit, the new tariff corresponding to a charge of 1 mark 20 for twenty words, would have presented, relatively to the old one, an increase of omk. 70, or 140 per cent. for the first zone; omk. 20, or 20 per cent. for the second zone; and a reduction of omk. 30, or 20 per cent. for the third zone. But the abrogation of any minimum of words having had the natural result of lowering the average extent of the telegram under the old minimum of twenty words, and, according to figures brought before the Reichstag, by Dr. Stephan the Postmaster-General, of reducing it to fourteen words, which corresponds to an average charge of omk. 90, the effective results of the reform appear in reality, for the first zone, in an increase of charge of omk. 40, or 80 per cent., and for the second and third zones, in reductions amounting respectively to omk. 10, and omk. 60, or 10 and 40 per cent.

As to the financial consequences, it is difficult to make them out at present with any certainty; on the one hand, because the short time of application has not allowed of sufficiently extensive statistics being furnished, and on the other, because the reform of the tariffs has coincided with a reorganisation of the service, which must have had a sensible influence on the economy of working. It may be noted, that, according to the Postmaster-General's statements, under the old *régime*, the budget of the Administration of Telegraphs showed annually a considerable deficit, amounting in 1875 to about 4 million marks; that the average payment for a telegram was omk. 78, and that the average net cost was 1 mk. 10, or for every telegram there was a loss of omk. 32, whereas under the new conditions, the average payment is risen to omk. 85 (while it is not possible to estimate the net cost, in consequence of the fusion of postal and telegraph services). On the whole, the result may be considered good; being advantageous to the Administration, whose deficits it tends to attenuate if not to abolish altogether; and unquestionably favourable to the public, since, except for local traffic in the narrow limits of the old first zone, there has been general reduction, a reduction small indeed for the traffic of the old second zone, but becoming well marked for all the traffic beyond that.

It could hardly be matter of surprise, however, that, on the occasion of discussion of the Postal and Telegraph Budget of the empire in November last, the interests affected by the new tariff raised a protest against the new system. Something of the kind must always attend the substitution of a uniform tariff for differential tariffs, where the uniform charge is not so low as not to exceed the least of the differential charges. An abstract of said discussion will be found in an article in *Journal Telegraphique*, of 25th December, 1876, from which the foregoing particulars are taken. Suffice it to say here, that notwithstanding reiterated efforts by the representative of the Government, the Reichstag adopted by a majority of 116 votes against 94, the proposition advocating re-establishment of the first zone, with a propor

tional charge of 3 pfennig per word in place of 5; the uniform fixed charge of 20 pfennig remaining unaltered.

The system of zones, it may be remarked, almost universally adopted at the introduction of telegraphs, has nearly everywhere given place to the uniform tariffs, as the communications have become more extensive and frequent, and as the charges have gradually diminished. Inaugurated in Spain by the law of 25th February, 1861, and in France by that of 3rd July of the same year (with an exception in favour of departmental traffic which still continues), the new *régime* came into practice in this country when the Government took over the telegraphs. Then it was introduced by Italy in 1871, by Austria-Hungary, after several transition steps, in 1873, and lastly, by Germany in the early part of last year. The system of zones still subsists in Russia and Turkey, countries which have Asiatic possessions of much larger extent than their European, and are thus hardly comparable with other European states.

It may here be interesting to note certain new facilities introduced into Germany since the fusion of the Postal and Telegraph service there.

Telegrams to be sent may be deposited either in post-offices, or in the letter boxes, or in the travelling offices of railway trains, or in the hands of postal or telegraph messengers. Excepting the last, which are subject to an excess-charge of 10 pfennig, those various modes of deposit do not in general involve any extra expense. If, however, a telegram sent to a post-office has to be conveyed by express to the neighbouring telegraph office, the expense of this special carriage is charged to the sender.

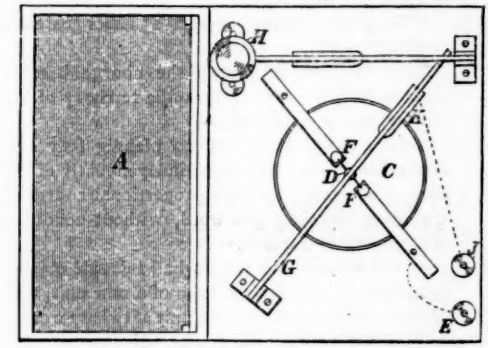
The telegrams brought to post-offices or to travelling offices can be written on the special forms for telegrams or on post-cards; they must, as a rule, be entirely prepaid in telegraph stamps; otherwise they are only despatched after the sender has paid the complement of the charge. In the case of deposit in travelling offices, however, if the sender is not a passenger by the train in which the postal *employé* can, during the journey, procure the failing portion of the charge, the telegram is sent with an annotation requiring payment from the receiver, and is not delivered till such payment is made.

The telegrams handed to telegraph messengers or postmen may be paid for in stamps or in coin. If not fully prepaid, their transmission is delayed till such payment is made. The messengers are provided with telegraphic tariffs for instruction of the public. They may not wait more than five minutes for a telegram to be given them, and if their rounds have not been completed at the time, they must tell the sender this, and so prevent the delay which would result.

THE TELEPHONE.

AT the conversazione of the Society of Telegraph Engineers, held a short time since, a Telephone, differing in some material respects from those previously made, was exhibited by the Messrs. Cecil and Leonard Wray, Jun.

Like all other instruments of this class, it consists of two parts—viz., a *transmitter* and a *receiver*. The transmitting instrument differs from that of Reis in having an inner membrane, B, so placed as to protect the outer or transmitting membrane C, from the action of the breath, and other disturbing influences, and also to amplify its vibrations.



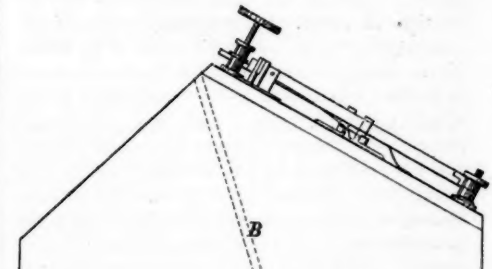


FIG. 1.

By fig. 1 it will be seen that the instrument consists of a rectangular box having a gable-shaped top, one half of which is open, while the other is covered by a piece of wood having a large circular hole, into which is fitted the drumhead (formed of thin india-rubber). In the centre of

this drumhead a small disc of platinum foil D is affixed, and is connected with the binding-screw E by means of two fine copper wires, which dip into the small mercury cups F F. By this arrangement the membrane is quite free, and consequently will vibrate to high, or to feeble notes.

To the lever G a platinum wire is attached, so as to almost touch the centre of the metal disc; and is adjusted by the screw H through the medium of the level I. The binding-screw J is connected with the lever G through the spring K.

Fig. 2 represents the receiver.

L L are bobbins filled with fine wire; in the centre of each helix is a light bar of soft-iron, which as they do not touch the bobbins, can vibrate freely. The outer ends of the bars are soldered to pieces of flat brass, held in position by the screws M M, while their inner ends are placed so as to be almost in contact with each other. N N are binding-screws, to which the ends of the coils L L are attached. The coils are so wound that they impart to the inner ends of the soft-iron bars, opposite polarity.

O is a box, made of thin wood, in the top of which (directly under the inner end of the electro-magnets) is a sound hole; and inside the box, near this hole, is a sound post.

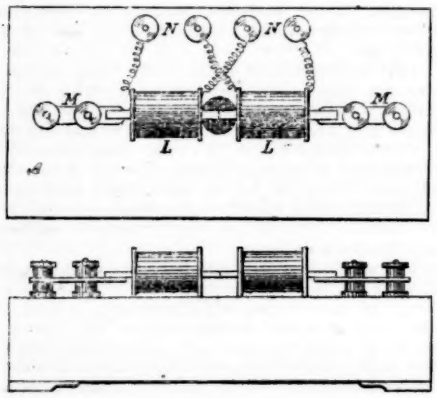


FIG. 2.

The sounding-box so constructed, while serving the purpose of a stand, also very materially increases the tones emitted by the electro-magnets.

When a note is sung into the opening A of the transmitter, it causes the membrane B to vibrate; this in its turn communicates the vibrations to the drumhead C. If the note sounded is the bass C the drumhead will vibrate 128 times per second, and will cause the platinum disc to form that number of contacts per second with the wire attached to the lever G. At each contact a circuit is completed through the coils of the receiver, and produces a sound resembling that made by the "death-watch," which by rapid repetition forms the musical note sung into the transmitter.

ON THE PROPAGATION OF ELECTRICITY IN CYLINDRICAL CONDUCTORS.

SUPPOSE a stream, on which dwell two millers. Suppose, further, that below the lower mill is a very high sluice, which may cause the water so to accumulate, that ere long the upper mill also comes to a standstill. Then, evidently, the lower miller might give a signal to the higher, by stopping the flow of water, and another signal, by liberating it again. If the lower miller draws his sluice, his mill is at once set agoing; not so, however, his neighbour's higher up, which will only begin to work when a certain quantity of water has flowed off below. The reverse occurs when the lower miller stops the flow of his water by shutting the sluice. The lower mill will then immediately come to a standstill, but not the higher one. This will only stop its work when so much water has run through its wheel that it acquires backwater; this occurs later, the longer the distance between the two mills.

This simile is used by M. Theodor Wand, in a recent paper in *Carl's Repertorium*, to illustrate what happens in electric telegraphy. Suppose a line beginning in A and ending in B; and also an insulated return line from B to A. At B is the electro-motive battery, at A and B there are writing apparatuses, and at A an arrangement for interruption of the current, so as to give signals. Let the circuit first be open; then in the two end points at A are found free electricities. The potential level of the electricity in one part of the wire is according to a known law $= +\frac{1}{2}E$, in the other part $= -\frac{1}{2}E$, where E denotes the whole electro-motive force of the battery. If now the circuit be closed at A, a current *immediately* flows through the apparatus at A; but through B only when so much electricity has passed through the piece of wire between A and B, that here also a perceptible current can arise. The like occurs when the circuit is again opened at A. Then the current at A ceases immediately to flow; but at B only after so much electricity has flowed away from B to A, that there, too, a perceptible current can again occur.

If we call the whole intensity of the current J, the intensity required to set the recording apparatuses in action J′, then in the former case the apparatus will immediately begin its writing; but the apparatus in B only when the intensity of the current passing through B has risen to J′. On breaking the connection again, at A, the writer at A will immediately cease to write, but that at B only when the intensity of the current passing through B has sunk from J to J′.

If we place two pieces (P and Q) of the paper strips given off by the two apparatuses, parallel with each other, so that the parts of the strips in vertical line are the parts which passed simultaneously under the two pens; then to a line a B, on the upper strip, corresponds a line a' B′ on the lower, which is not vertically under it (but displaced, say, to the right), and not, perhaps, of the same length. Let the time which elapses till the current in B rises, after connection is made, to J′, be T, and let $J' : J = 1 : 20$, then the time T′ which is necessary after breaking, to bring down the intensity J

to J', will evidently be greater than T, and the line a' B' longer than the line a B. If, on the other hand, J' : J be nearly equal to unity, T will be longer than T', and the line a' B', shorter than a B. If, therefore, a strong current is used, the intervals must have a certain size in order to appear distinctly at the other station; if a weak current be used, the length of the (signalled) line must be sufficiently great to be visible at the corresponding station.

In this representation it is, of course, understood that the writing apparatuses are constructed perfectly alike, and that the differences in the time they require to be put in motion may be neglected. The complex problem of determining the velocity of propagation of telegraphic signals is then limited to two questions:—

1. How great is the time which elapses after closing the circuit at one end, before the intensity at the other end rises to J'?

2. How great is the time which elapses after opening the circuit at one end, before the intensity at the other end sinks to J'?

M. Wand proceeds to an analytical treatment of the problem, for which, however, we must refer to the original, merely giving here the principal results, which are stated as follows:—

1. The mode of propagation of disturbances of electric equilibrium is different, according as the resistances to be overcome are great or small.

2. With small resistance (in general up to the resistance of a copper wire 120 to 400 kilometres long and 2mm. diameter), the equalising of the disturbances of equilibrium takes place with oscillations, whose amplitude decreases more quickly, the greater the resistance. The velocity of propagation of disturbances is, with wires of small curvature, at a maximum, equal to the velocity of light, and decreases with increasing resistance.

The electric motion is in this case to be compared to the to-and-fro movement of a water-mass in two basins, which are connected together by a short and wide canal offering little resistance.

3. With greater resistance (in general from the resistance of a copper wire 1000 kilometres long and 2mm. thick, onwards), there is no longer oscillation. The velocity of propagation of the disturbances of equilibrium is inversely proportional to the whole resistance, and also inversely proportional to the length of the line; and so, with equal resistance of the unit of length, inversely proportional to the square of the length. The equalising of the disturbances of electric equilibrium occurs here similarly to the equalising of the level of water-masses in two basins, which are connected together by a long or narrow canal.

4. The problem of determining the velocity of propagation of electric signals, which are given by magnetic apparatus, is, only for great resistances, identical with the problem of determining the velocity of propagation of disturbances of electric equilibrium. Whenever the equalisation occurs with oscillation, the two cases are different. The magnetic apparatus is, as indicated at the outset, comparable to a mill. So long as oscillations occur, the mill-wheel will not constantly turn in the same direction, but will be driven to and fro. Only after the oscillations cease, will the wheel turn regularly, or, in our case, the magnet begin to work. It is therefore not to be wondered at, if for the propagation of electrical signals through magnets, quite different and less velocities are obtained. as compared with those for propagation of the disturbances of equilibrium.

M. Wand compares his theoretical results with the experiments of Walker and Gould, Wheatstone, Feddersen, and Siemens, and finds a general agreement.

COMPARISON OF THE BATTERIES USED IN TELEGRAPHY.

REPORT OF M. GAUGAIN UPON THE VARIOUS TYPES OF DANIELL, CALLAUD, MARIÉ-DAVY, AND LECLANCHÉ BATTERY.

(Concluded from page 319, vol. iv.)

AFTER further description of his method and of his researches on electro-motive force and resistance, M. Gaugain comes to the following conclusions:—

The Daniell battery used by the administration of telegraph lines, and the small size Callaud battery, always became unserviceable, the former in four to five weeks, the latter in about two months. These batteries have to be very frequently renewed, and I think their use should be given up.

The electro-motive force of the large Callaud has not diminished more than a tenth in an interval of five months, and it would probably take a much longer time to become unserviceable. I think therefore, it is very convenient for telegraphy; it requires some attention, since the sulphate of copper has to be renewed as it gets exhausted, but it has the advantage of being able to furnish currents of any intensity without sensible polarisation.

The sulphate of mercury batteries do not seem to alter much when inactive; the electro-motive force in one series of experiments remained absolutely invariable for five months. The increase observed in the resistance, in some cases, must be due to accidental causes, which may be avoided.

The destruction of Marié-Davy batteries is in general only the consequence of work done; they become unserviceable only when their supply of sulphate of mercury is almost entirely consumed. Now the large couples in one series were constantly in action for five months, without the electro-motive force being diminished. If we suppose that in the transmission of a telegram the circuit remains closed for three minutes (this estimate I believe exaggerated), then the quantity of electricity put in circulation in a circuit constantly closed would suffice to transmit at least 75,000 telegrams. As there are probably no offices which send, in one year, this number of telegrams with the same battery, it follows that the large Marié-Davy may be used even in the most important offices without requiring renewal more than once a year.

Those of the small size retained their initial electro-motive force during intervals which varied from two to seven weeks. I regard it as certain

that such couples will furnish during a month at least the current of intensity 1. Now the quantity of electricity put in circulation during a month, in a circuit constantly closed, would suffice to send 15,000 telegrams. The small couples then might be used in offices which do not send more than 15,000 telegrams per annum, without having to be recharged more than once a year. But these couples have the inconvenience of being strongly polarised when they are traversed by currents more powerful than those whose intensity I have taken as unity, and perhaps it would be preferable to use every where the large size, which is much less polarised under the same conditions.

Leclanché's battery is not notably altered when inactive; its duration depends exclusively in the work it does and the quantity of peroxide of manganese it contains. Leclanché couples placed in a circuit constantly closed retain for about two months an electro-motive force superior to that of a Daniell couple, when the intensity of the current does not exceed the unit intensity. Hence the Leclanché battery might send 30,000 telegrams at least, before becoming unserviceable, and so it might be used in most stations without needing renewal more than once per annum.

Leclanché's cell has the advantages of cleanliness, of not containing any poisonous substances, its resistance is very small, and its price will be low when the patent expires. It has the disadvantage of becoming strongly polarised when traversed by currents slightly above unit value, but this might be obviated by increasing the size of the cells.

The ammonia which is evolved when this battery is at work would become inconvenient and even dangerous for persons in its immediate vicinity if a large number of cells in constant work were employed; but if Leclanché's cells are fitted up at small offices only, no fear need be entertained on this head. If necessary, steps could be taken to abolish the nuisance.

Notes.

IN the death of the veteran Professor Poggendorff, of Berlin, last month, physical science has lost one of her most diligent and ardent votaries. Born at Hamburg in 1796, he entered, at sixteen, the establishment of a pharmaceutical chemist there, and after eight years, went to Berlin University, where he became Professor of Physics in 1834, and in this post he continued till his death. In his first paper "On the Magnetism of the Pile," published in 1821, he describes the discovery of the multiplier. Becoming editor of the *Annalen der Physik und Chemie* in 1874, he brought to the task such breadth of knowledge, discrimination, and enthusiasm, as rapidly gained a foremost position for the *Annalen* among scientific journals; and the long series of one hundred and sixty volumes which have since appeared form a lasting monument to his industry and zeal in the cause of science. Some three years ago, it is known, the occasion of his editorial jubilee was celebrated by the presentation of a *Jubelband* from his *collaborateurs*. Poggendorff's researches were chiefly in the domain of electricity and magnetism, and are of no ordinary value; they were mostly brought before the Berlin Academy, of which he became a member in 1839. He invented the magnetometer for the measurement of minute magnetic variations, and devised several beautiful arrangements for determining the force of voltaic currents in relation to deflections of the galvanometer needle. His labours in the study of electro-chemical and thermo-electric phenomena, the laws of galvanic polarisation and diamagnetism, the resistance of various conducting mediums, &c., have enriched electrical science largely. Among other works of Poggendorff was "A Biographical, Bibliographical, and Historical Dictionary of the Exact Sciences," including biographies and fragments of works, and papers of the scientific men of all nations and times.

An interesting experiment is about to be tried at Antwerp. The city engineer has been authorised to introduce the Gramme method of lighting into the docks and basins of the city, so that the process of shipping and loading will go on as briskly by night as by day.

The electric light is becoming common in Paris in connection with works that have to be carried on during the night. A large lamp, fed by a six-horse power, has been established in the Avenue de l'Opéra, and others are employed in the Trocadero in connection with the building of the Exhibition Palace. The Gramme machine and screw regulator are employed.

According to a Belgian horticultural serial, an electrical plant has been discovered in Nicaragua. In attempting to gather a branch a shock is felt by the hand, as from an electrical machine. The plant is said to affect the compass. It is a species of Phytolacca, named P. electrica.

There is also found in the prairie lands of the south-western parts of the United States, especially in Texas and Oregon, a plant called the "compass plant," "pilot weed," or "polar plant," *Silphiuno laciniatum*. Its leaves constantly turn towards the north, and it serves as a magnet to the traveller. Longfellow alludes to it thus:—

"Look at this delicate plant, that lifts its head from the meadow,
See how its leaves all point to the north, as true as the magnet;
It is the compass-plant that the finger of God has suspended
Here on its fragile stalk, to direct the traveller's journey
Over the sea-like, pathless, limitless waste of the desert."

At the meeting of the Physical Society on Saturday, February 17th, the following communi-

cation will be made:—"On an Apparatus to illustrate Wave-Motion," by C. J. Woodward; "On the Vapour Tension of Combined Water," by Prof. F. Guthrie; "On a New Lantern Galvanometer," by S. P. Thomson.

Information was received in Liverpool the other day, of the destruction of the fine American ship Dakota through being set on fire at sea by lightning. She was a new ship of some 1,400 tons register, and was built and owned in the city of Bath, Maine. At the time of the disaster she was on a voyage from New Orleans to Liverpool with a cargo of cotton, and she had several passengers on board. On the 7th inst., when in latitude 41.30 N., long. 37.50 W., she was struck by lightning and set on fire. All efforts were at once made to put out the flames, but without avail, and by daylight on the following morning her decks were burnt through. The passengers and crew succeeded in launching the boats and getting clear of the ship; and on the 10th they were picked up by the German brig Hedwig.

PHILADELPHIA, FEB. 13.—The House of Representatives have passed a Bill which had already passed the Senate, authorising the laying a telegraph cable between the United States and Europe, provided the tolls shall not exceed one shilling per word. The announcement is made that the cable will be laid this year, under the terms of this Bill, between Baltimore and Europe.

The report of the Submarine Telegraph Company shows that the total receipts for the six months, inclusively of the balance brought forward, amounted to £34,303. This sum enables the Directors to recommend a dividend at the rate of 17½ per cent. per annum, and to carry forward a balance of £937.

The Eastern Telegraph Company's monthly abstract for January shows that the average time of transit of messages from Calcutta to London was 48 minutes, and from Bombay 42 minutes.

The Directors of Hooper's Telegraph Works have issued a circular to the shareholders, stating that owing to heavy claims upon the Company which they are unable to meet, it is imperative that decisive steps should be taken for raising fresh capital or for winding up the undertaking. For this purpose an extraordinary meeting is called for Friday, the 16th inst.

It appears that in the course of the half-year ending Sept. 30, 1876, the Eastern Telegraph Company (Limited) paid £261,200 on account of its duplicate Red Sea and Indian Ocean cables.

The Directors of the Telegraph Construction and Maintenance Company propose paying a dividend of 15 per cent. (£1 16s. per share), in addition to the *ad interim* dividend of 5 per cent. already paid, making 20 per cent. for the year.

TRAFFIC RECEIPTS.

Brazilian Submarine Telegraph Company, for January, £11,469, against £12,146 in January last year. During the month the Company's Rio-de-Janeiro section was interrupted for twenty-two days.

Great Northern Telegraph Company, for January, 316,565fr., against 275,252fr. in January last year.

Western Brazilian Telegraph Company, for January, £10,100, against £11,417 in January last year.

Direct Spanish Telegraph Company, for January, £983, against £1,346 in January last year.

Cuba Submarine Telegraph Company, for January (estimated), £2,300, against £2,410 in January last year.

Direct United States Cable Company, for week ending 6th January, £3,050: 13th, £3,560; 20th, £3,320; 27th, £3,600; 3rd February, £3,850; 10th, £3,900.

West Coast of America Telegraph Company, for four weeks ending 18th November, 1876, £2,898.

City Notes.

Old Broad-street, 14th February, 1877.

THE following letter from Messrs. Bircham and Co., of Threadneedle-street, the Solicitors to the Globe Telegraph and Trust Company, has been forwarded to us:—

60, Threadneedle-street, London, E.C.,
6th February, 1877.

GENTLEMEN,—The attention of our clients the Directors of the Globe Telegraph and Trust Company has been called to an article in the TELEGRAPHIC JOURNAL of the 1st instant, purporting to describe the objects and position of that Company.

There are many mis-statements in the article, of minor importance, which the Directors do not trouble to refer to, but others are of so serious a character that they cannot allow them to pass uncontradicted.

They are contained in the three following paragraphs:—

"It appears, however, that for some unexplained reason or other a great many of the telegraph shares bought by the Globe were bought as dearly as they could possibly be paid for. Thus £261,000 of Anglo-American stock were acquired at an average price (as per balance sheet) of 69, whereas during the whole of the financial year in which this transaction took place, only on four days were Anglos as high or higher than 69. Why should the Globe Directors have chosen out of the 365 days which a year is commonly supposed to have, one of those four when Anglos were dearest?

"Thus Direct Cable shares were obtained at a price of 11¾, and only on one day during this year were Directs as high or higher than 11¾; why again

acquire on this particular day? German Unions were bought apparently on the one day when they were dearest, and Indo-Europeans on one of the six days out of the year when they were dearest.

"So far the transactions carried out on behalf of the Globe Company by their Directors display, to say the least, a singular want of judgment.

"Looking at the whole of the Globe investments, it appears that on 18th July, 1876, the market value of the shares and stocks held by the Company was less than £2,000,000, whereas the cost to the Company of these identical securities appears to have been £2,978,029 15s. 4d.

"This enormous difference does not seem to indicate a triumph of the Directors' judgment."

In these paragraphs you make it appear that the Globe Company have paid cash for the various shares acquired, and as 69 for Anglo-American and 11¾ for Direct Cable Shares was higher than the average price in 1876, it is insinuated that there has been some misconduct, or at the least great want of judgment, in the action of the Directors in regard to the purchases made, and you go on to allege that the Company has sustained a loss of £978,000 on the whole of its investments.

All these statements and insinuations are without the smallest foundation, and it appears to the Directors that only by wilful blindness could the writer of the article have failed to see this.

The earlier part of the article states that the leading principle of the Globe Company is the *exchange of its own shares* for the shares of other Companies, so as to consolidate the several classes of Telegraph Investments, and practically guarantee a dividend by distributing the risks incidental to such enterprises.

The printed statement of the shares held by the Company annexed to the Report of 21st July, 1876, which was before the writer of the article, states in terms the "*Cost in Preferred and Ordinary Shares of Globe Company by Exchange or Sale and Purchase*," showing clearly that the figures stated represented the cost of the Company's investment in Globe Shares, and not in cash.

Instead of there being a heavy depreciation in the value of the Company's investments, we are informed that in fact the market value of the Globe Shares has always been considerably in excess of the market value of the shares of other Companies for which they were exchanged.

The misrepresentations in the article complained of are very damaging to the Shareholders, as well as to the Directors of the Company, and having been made under circumstances which apparently exclude the presumption of ignorance of the facts, we are instructed to request that no further copies of the Journal containing the Libel be sold, that this letter be inserted in your next issue, with an explicit withdrawal of the misstatements referred to, and an apology for the injury done. If this is not accorded, our clients will take proceedings against you in the Courts of Law.

Your obedient servants,

BIRCHAM & Co.

To the Editor, Publisher, and Proprietor
of the TELEGRAPHIC JOURNAL.

We must confess that when we received the above letter we were more than astonished. That a discussion of the management of a Trust Company, or, for the matter of that, of any Company, should be damaging to the Shareholders of such a Company, is certainly "the latest thing out"; that it may sometimes be damaging to the Directors, we admit.

We have always been under the impression, which we now, however, perceive to be a misapprehension, that the interests of a shareholder did not suffer so long as the intrinsic value of his property remained the same, and how in the name of goodness the dividend-earning power of any concern can suffer from a discussion as to the ability of its guardians, we confess ourselves at a loss to understand. However, from the tone of Messrs. Bircham and Co.'s letter, it is quite evident to us that they must be right, and that we must be wrong. Supposing therefore, for argument's sake only, that the management of the Globe Company is injudicious, it will hurt the Shareholders' interests (that means the intrinsic value of their property) if anybody dares to say so. If this be true—and as Bircham and Co. say so, it must be true—we beg then most distinctly to apologise to the Shareholders for any damage we may have done them by the publication of the article in our last issue.

As regards the Directors, we had thought that an article in the columns of our modest JOURNAL could have done no damage whatever to men who hold so exalted a position as they do, and to whom fluctuations in the market-value of securities involving hundreds of thousands of pounds appear to be a matter of but trifling importance, and hardly worth mentioning. Should we, however, have done any damage to them, we also beg most humbly to apologise.

As to the various "mis-statements" contained in our last, we wish to point out to Messrs. Bircham and Co. that, although we never represented that Globe purchases were effected for *cash*, we might easily have fallen into such an error, just because the last Globe balance-sheet was before us when we wrote the article in question. The column setting out the "cost in Preferred and Ordinary Shares of Globe Company by Exchange or Sale and Purchase" is headed with the three hieroglyphic signs—£ s. d. In the modest transactions, which we have from time to time had occasion to enter into, we have invariably been taught to read those signs as "pounds," "shillings," and "pence": it appears, however, that when one comes to deal in such large amounts of shares as the Globe Company deals in, these signs mean something else—say some fancy paper currency. Looking at the Prospectus of the Globe Company, we find the following paragraph:—"Subscriptions in cash for the £10 Preference and £10 Ordinary Shares will be received as follows," &c. It would have been pardonable, therefore, we humbly submit, to imagine that a Globe Share of £10 was worth £10, and that the amounts paid in the paper currency of the Globe Company for the investments of that Company had a similar value to the ordinary money of this country.

However, we beg explicitly to withdraw the misstatements made in our last issue, and now complained of, and in their place we will substitute what by the light of Messrs. Bircham and Co.'s letter we perceive to be the case:—

The cost to the Globe Telegraph and Trust Company of "Stocks and Shares held by the Company" was, on the 18th of July, 1876, £2,978,029 15s. 4d. The market-value of these identical securities at that time was £1,905,238 4s. 5d., in ordinary British pounds, shillings, and pence. It appears from the prospectus of the Globe Company that amongst others Anglos were to be taken at *par*, as well as Eastern and Eastern Extension Shares, and were to be paid for in Globe Shares, which, according to the valuation then put upon them by their own Directors, were worth ten pounds sterling in *cash* for every ten pounds in Globe *paper* (whether Preference or Deferred). On the 18th of July, 1876, as per the "Money Market" in the *Times*, Anglos were quoted at 57½-58, Easterns 6⅛-6⅜, and Eastern Extension 5⅜-6½. With all deference, therefore, to Messrs. Bircham & Co., we must maintain that there *is* a difference in the Market-values of

the stocks and shares held by the Globe Co. at the times when acquired and when reviewed by us.

Amongst other matters in their letter Messrs. Bircham & Co. mention the following: "We are informed that, in fact, the market-value of the Globe shares has always been considerably in excess of the market-value of the shares of other Companies for which they were exchanged." Now, by the "market-value of any shares," &c., we understand the amount in British sterling coin which can be obtained for such shares by selling them in the market. If, therefore, the market-value of Globe Shares was "always considerably in excess" of that of those shares for which they were exchanged, it seems a pity that such exchange took place at all, and that Globe Shares were not sold in the market (which we suppose has never been done), and that with the ordinary British currency thus realised the desired shares of other Companies were not bought likewise in the market.

We must confess that the transactions of the Globe Company appear to us to be "one of those things that no fellow can make out;" and should we again be guilty of a misrepresentation, we hope to be corrected by Messrs. Bircham and Co. But, so far as we can at present see, the process is as follows:—The Globe wishes, for instance, to buy Anglo Shares (for which, by the way, they seem to have a particular fondness, having according to the Chairman of that Company, now increased their holding up to £1,250,000); it gives its broker or agent Globe Shares for the amount, and the Globe Shares having a market-value considerably in excess of the market-value of the Anglo Shares, the broker must make a pretty good thing of it—better, perhaps, than the Globe Shareholder does.

We are bound to say that, if our present view be correct, we should not object to being a Globe broker.

We hope that our apology to the Shareholders and Directors of the Globe Company will be found to be satisfactory, and that the misrepresentations contained in our last issue having been replaced by what now appears to us to be a correct statement, the Directors of the Globe Company will be happy, and sleep again the slumber of the just.

So much space has been necessarily devoted to this subject, that little room is left in which to take a passing glance at the changes which have been going on around us during the past fortnight. The subject uppermost in every telegraphic circle, and that which seems to have in some instances even temporarily paralysed operations, is of course the dispute still raging between the Globe Company and the Direct United States Cable Company. We have already expressed our views on the points at issue between them, and we cannot put more pithily the question, really affecting not only telegraphic interests, but public interests generally, than by quoting *verbatim* the language of the *Times* of the 5th inst. upon this subject:—

"The contest now going on for the possession of the Direct United States Cable Company is of a very curious kind. To-day it may be said to have reached its second stage, and so far the monopolists and speculators have been beaten. Their defeat was immediately reflected in the Stock Exchange, where the price of the shares fell as well as that of the Anglo-American Company. It is not our province to say whether the decision of the Chairman—by ruling out the excess votes over 100, which he said was the *maximum* that any one corporation could use under the articles of association, and which caused the defeat of Mr. Pender's party—is based on strict legal rights or not; but every independent shareholder must feel that it is at least equitable. Nothing could well be devised more destructive to joint-stock enterprise than this machinery of "trusts," by which the controlling power over companies may be acquired and exercised in defiance of every private right by a group of speculators. That this movement to get possession of the Direct Company is the enterprise of a few, working partly through the "Globe Trust," is beyond question, for the movement did not begin before last September, and we have a list of the shareholders of the Direct Company in our possession, which shows that the bulk of the shares held by the fusionists has been acquired since then. Their interest in the welfare of this Company is therefore of remarkably recent origin—it, in fact, dates from the time when the competition of the Direct Company may be said to have begun to tell seriously on the receipts of its rival, and therefore on the value of the enormous stake which the Globe Trust has in the stock of that rival."

This speaks for itself, and coming, as it does, from what most people will feel inclined to regard as the highest authority in the world, requires no weak words of ours to be added to carry conviction with it.

Proceedings of Societies.

PHYSICAL SOCIETY—3RD FEBRUARY, 1877.

Prof. G. C. FOSTER, President, in the chair.

THE following candidate was elected a member of the Society:—Mr. J. Norman Lockyer, F.R.S.

PROF. OSBORNE REYNOLDS exhibited a number of experiments in relation to vortex motion in fluids. The well-known rings formed by puffs of smoke have been studied by many high authorities, but not with a view to their general bearing on this subject. Prof. Reynolds showed smoke-rings and their interference by means of the apparatus devised by Prof. Tait, and added that although the theory of smoke-rings does not imply that vortex motion is peculiar to vapours, their existence in liquids was only pointed out by Mr. H. Deacon at a comparatively recent date. If a flat disc be supported on a light frame, and caused to move rapidly through water, the motion ceases on withdrawing the hand suddenly; but, if this be done gradually, the motion continues. By passing a coloured liquid down a fine tube to the back of the disc, he found that a vortex ring is always formed, which passes to to the rear of the disc, and the same effect is produced by dropping water from a height, into water covered with a coloured liquid. In a trough about six feet long, and at one end of which was a horizontal tube closed with sheet india-rubber, air-rings were formed by introducing air into the tube, and then striking the india-rubber externally; and it was shown that a ring is capable of propelling a vane placed in its course. If the air be replaced by a coloured liquid, the ring travels with considerable velocity, and the motion of a solid body of the density of water is in no degree comparable. If a ring travels through a part of a liquid which has previously been coloured, it causes no motion of translation, and Prof. Reynolds concludes that no resistance is offered to their motion. After adverting to the methods adopted to ascertain the direction and velocity of motion, the initial form of the rings was shown to be a spheroid. A solid of this form, however, is very slow in its passage through water, and he considers this to be due to friction. He has succeeded in imitating the form of the ring by causing a disc, surrounded by pieces of ribbon, to move through water. Finally, Prof. Reynolds referred to Sir William Thomson's researches on the interference of two rings, and showed that the oscillating rings so produced can be formed in liquids by employing an oval in place of a circular aperture.

The Annual General Meeting of the Society was then held.

The PRESIDENT read the Report of the Council, of which the following is a brief abstract:—The Council points with satisfaction to the number and interest of the papers read before the Society, and a brief summary is given of the more important. The Society has to regret the loss of three of its members—Mr. David Forbes, F.R.S., Mr. A. S. Hobson, and Mr. Arthur Pinn. The publication of a new edition of Prof. Everett's work and of a complete edition of Sir Charles Wheatstone's writings is announced, and the Council hopes shortly to undertake the translation of scientific papers from foreign sources to be published in its Proceedings.

The following Officers and Council were elected for the ensuing year:—PRESIDENT, Prof. G. C. Foster, F.R.S.; VICE PRESIDENTS, Profs. W. G. Adams, F.R.S., and J. H. Gladstone, F.R.S., Mr. W. Spottiswoode, LL.D., F.R.S., Sir W. Thomson, LL.D., F.R.S., and Dr. W. H. Stone; SECRETARIES, Prof. A. W. Reinold, and W. C. Roberts, F.R.S.; TREASURER, Dr. E. Atkinson; DEMONSTRATOR, Prof. F. Guthrie, F.R.S.; other Members of Council, Prof. W. F. Barrett, Latimer Clark, Major Festing, W. Huggins, D.C.L., F.R.S., Prof. Kennedy, O. J. Lodge, Prof. H. Macleod, Prof. B. Stewart, LL.D., F.R.S., Prof. Unwin, and E. O. W. Whitehouse.

The proceedings terminated with votes of thanks to the Lords of the Committee of Council on Education for the use of the Physical Laboratory at South Kensington, and to the several Officers of the Society.

THE SOCIETY OF TELEGRAPH ENGINEERS.

PROFESSOR ABEL'S INAUGURAL ADDRESS.

(Concluded from page 34.)

IN addition to his investigations into the deterioration of gutta percha, Dr. Miller carried out a series of exhaustive researches into the manufacture and behaviour of india-rubber for insulating purposes. He pointed out that mastication promoted the oxidation of india-rubber, and further experience has established the fact that in this respect the two gums—gutta-percha and india-rubber are very much alike.

The application of vulcanising to india-rubber was hailed as a most important step in submarine telegraphy; but although many chemists have made this same process of vulcanising a subject for study and investigation, it remains imperfectly understood even to the present day. The wire manufacturer had no difficulty in most important objection urged against the application of the vulcanising process (viz., the injury done to the conductor by the chemical action of the sulphur in the dielectric upon it) by availing himself of the fact that tin would not be equally affected, and so protecting the copper by the simple process of tinning. Still the tendency to an alteration, either in the chemical or mechanical structure of vulcanised india-rubber, or of both, exhibited by it when kept submerged in water, has developed serious elements of uncertainty in cables prepared by the vulcanising processes. Prof. Abel then proceeded to give some interesting illustrations drawn from his own personal experience of the uncertainty of our existing knowledge regarding the chemical and other conditions to be fulfilled in the application of vulcanising processes to the preparation of telegraph cables.

A number of half-mile lengths, for instance, of vulcanised telegraph cable—some for field-service, others for firing broadsides on board ship—were found, after a period varying from eighteen months to three years, to have undergone considerable deterioration; the dielectric in some instances had become so porous that even the variations in the hygroscopic condition of the atmosphere on board ship, where the wires were placed between decks, caused decided differences in the results obtained with a particular battery power; and this alteration was not distributed uniformly over a length, the porosity in some instances extending along a few feet only, leaving the adjacent portions in very good condition; an inspection of a large quantity of the same sort of cable which had remained untouched in store showed precisely similar results.

The uncertainty attaching to this was still further illustrated by the fact that in armoured cables with multiple cores of this description some of the cores remain comparatively good, whilst the insulation of others had fallen off to a very great extent.

Scarcely less conflicting is the experience gained with cables prepared according to Hooper's system. This system consists in maintaining the inner portion of the india-rubber surrounding the conductor in an unvulcanised condition by means of a "separator," which contains a preparation of a metal possessing the power of arresting the passage of the sulphur beyond it during, and subsequent to, the application of the vulcanising process.

The deterioration, due to the alteration of the india-rubber, being caused by oxidation, the question naturally arises as to how the oxygen finds access to it? It must evidently find access to the interior of the dielectric *through the substance of the cable*—a view which is more than confirmed by the researches of Graham. That eminent chemist showed that solid india-rubber absorbed oxygen to an extent which showed the gas to be twice as soluble in it as in water at the ordinary temperature, and the comparatively greater porosity of vulcanised india-rubber would favour this absorption. The oxidation of unvulcanised india-rubber being once established, the tendency to the absorption of oxygen by the external vulcanised india-rubber, and to its passage through the latter, must be promoted by the increased tendency to chemical change of, and continual assimilation of oxygen by, the inner portion, which thus acts like the vacuum by which Graham caused air very rich in oxygen to filter through a stout vulcanised india-rubber tube.

The efforts made from time to time to improve the insulation of cables, served until recently only to clear the ground for future experiments, but of late important success seems to have been achieved in a direction where different experimenters (including Prof. Abel himself) had failed—that direction is towards paraffin, "a substance which during the last thirty years had passed from the obscure position of a chemical curiosity to the foremost rank amongst important chemical products." In 1875 Mr. Field, F.R.S., working in conjunction with Mr. Talling, the mineralogist, produced by means of a solvent, or by masticating the substances together, a black ozokerit-product with india-rubber, which appeared quite free from the brittleness which Matthiessen, who also had been at work here, failed to get rid of. This preparation in point of insulation and inductive capacity compares very favourably with india-rubber and gutta-percha, and would seem likely to prove very valuable for telegraphic purposes in the future.

Prof. Abel could only allude to the importance of chemical science in the proper management of batteries, a subject which, after a valuable paper read before the Society by Mr. Sivewright, "On Batteries and their Employment in Telegraphy," and the instructive discussions which it elicited, needed only to be named. Amongst other matters of importance where the telegraph engineers might derive great benefit from the fruits of applied chemistry, were the decay and preservation of telegraph poles, the preservation of fibrous

materials used in constructing submarine cables, the production of joints and the protection of cables against the deposition of vegetable or animal growth.

Prof. Abel then concluded his address by a final illustration of the manner in which the practical electrician may unexpectedly be brought face to face with problems which can be solved by a knowledge of chemistry and by that alone. Lieut.-Col. Stotherd, R.E., having pointed out certain defects in the permanency and difficulties connected with the testing of Abel's "phosphide" fuse, he (Prof. Abel) constructed another form of high tension fuse especially designed for submarine mining. The poles of this new fuse were 0·05 of an inch apart, in an insulating column consisting of Portland cement with sufficient sulphur to allow of its being melted and cast in a mould. Fuses manufactured in this way were supplied to eifferent military stations, and after a time it was found that, the average resistance of the fuses being 15,000 ohms, that of many of them had fallen as low as 300 or 400 ohms, and one or two had gone down even below 50 ohms. The cause of this at first sight inexplicable change in the stability of the fuse was traced by Mr. E. O. Brown to the existence in many of the cement pillars of very minute hair-line cracks or fissures extending sometimes right across the space between the enclosed small copper wires. The sulphur in the cement and the copper wire in presence of the air which had penetrated along with the ever-concomitant moisture had set up a galvanic action which had formed one or more complete bridges, thereby short-circuiting the copper poles. Chemical knowledge, which unravelled this mystery, at once, provided the remedy; platinum, upon which sulphur and air were powerless, replaced the copper, and the permanence of the fuse was secured.

Reviews.

An Introduction to the Theory of Electricity. With Numerous Examples. By LINNÆUS CUMMING, M.A., late Scholar of Trinity College, Cambridge; Assistant-Master at Rugby School. London: Macmillan and Co., 1876.

THIS little book, which is one of the well-known mathematical series published by Messrs. Macmillan, is a useful addition to the library of the Physical Science student. It possesses distinct points of novelty as compared with the text-books on Electrical Science which have hitherto been published.

To the practical electrician the book would be of but little value, as it deals almost entirely with the theory of the Science of Electricity.

The opening chapter we are inclined to think is rather out of place, for although the information it contains must be admitted to be necessary for working out the subsequent problems, it is of such a kind as the student must have mastered from those works on Mechanical Philosophy which he would have had to study before he could reach the step from which this work takes its start.

The tendency to introduce extraneous matter in scientific books is to be regretted, as although it no doubt gives them an imposing appearance, it causes valuable time to be wasted in going over ground that ought to have already been traversed, and must have been traversed if the journey is to be prosecuted with good effect.

The problems on Statical Electricity are dealt with in a very lucid manner; those having reference to Leyden Jars are of practical value, but we are surprised that the bearing these latter problems have upon the measurement of electrostatic capacities has not been pointed out, and a description of some tests such as are employed for cables would have proved useful.

In the chapter on the Theory of the Voltaic Cell, Mr. Cumming truly observes: "It is hardly too much to say that at present in no single instance has a difference of potential been directly shown between two bodies, independent of the gaseous medium between them, of the pressure with which they are brought together, and of the friction with which they are separated; the existence of such a difference of potential in every case lying at the very foundation of Volta's theory."

On page 167, Siemens' method of localising the position of a fault in a cable by means of simultaneous tests taken at both ends, is described, and we read:—"If the fault be at the middle of the cable, it is clear that the result is not affected by normal breakage, and if it be not at the middle, allowance can *easily* (the italics are our own) be made for the error it produces."

We are inclined to think that the correction of of this error is by no means such an easy matter as it is stated to be. We do not doubt Mr. Cumming's ability to solve this problem, but at the same time it seems to us hardly a satisfactory way of getting over the difficulty, by pronouncing in this off-hand manner that there is really no real difficulty to be encountered.

Le Télégraphe—Terrestre—Sous-marin—Pneumatique. By PAUL LAURENCIN. (Paris: J. Rothschild, Editeur, 13, Rue des Saints Pères. 1877.)

THE object of this attractive little book is stated to be "to give an idea of telegraphy to persons who are unacquainted with it—to explain the principal facts.....to those telegraphists who should know them, but too often are ignorant of them." Previous works on the subject are regarded as either too long or too succinct, while all are expensive. To produce "a complete theoretical and practical treatise" on telegraphy within the limits here assigned, would hardly be possible without careful "succinctness"; and the author's descriptions (good as far as they go) of a few of the more complicated apparatus, appear to us rather inadequate; as where the Wheatstone automatic system is disposed of in some three small pages of letter-press. Defects in this respect are to some extent made up by the number and excellence of the illustrations, which are a special feature of the book; some of the larger figures are spoiled, however, by the way in which they are extended across two pages. The first three chapters treat of ancient telegraphs, aerial telegraphs, and pneumatic telegraphy respectively; the third giving an interesting account of the pneumatic system in Paris, including the hydraulic apparatus employed for compression or rarefaction of air. After some explanations regarding electricity, the first electric telegraphs are briefly noticed, and we have chapters on currents, batteries, and terrestrial conductors. (The arrangement of matter in this part of the work

is, we think, open to improvement.) The author then describes the Alphabetic, Morse, printing, and writing systems, and auxiliary apparatus. There is a good chapter on submarine telegraphy, but we find in it no reference to the siphon recorder. An account of military telegraphy aids the comprehensiveness of the book. We note also a map of telegraphic communications over the globe; and a list of tariffs. In the concluding chapters (as indeed throughout) will be found a good deal of information about the working of the French telegraph system. The book may be heartily recommended to the class of readers it has in view, in this country as well as in France.

Journal of the Society of Telegraph Engineers. Nos. XIII. and XIV., Vol. V. (Double Number). London and New York: E. and F. N. Spon.

THIS double number, which fully sustains the reputation of the Journal, contains accounts of the proceedings at meetings of the Society from June to April, 1876, at which, following Mr. Walker's inaugural address, papers on Underground Telegraphs, the theory of submerging and testing submarine telegraphs, electric repeaters for railway signals, the work value of electromagnets enclosed in iron, &c., were read and discussed. Under the heading of "Original Communications" are a detailed description of the siphon-recorder and the automatic curb-sender, by Mr. J. A. Ewing, and short papers on the Persian Telegraphs, Mr. Willoughby Smith's new joint for covered wires, a new method of taking the loop-test, and other interesting matter.

Electrical Science in Foreign Journals.

COMPTES RENDUS OF PARIS ACADEMY.
No. 3: 15TH JANUARY.

The Phenomena of the Radiometer explained by Pyro-Electricity. By M. DE FONVIELLE.

ANY non-conducting body, submitted to the action of luminous rays, is heated, then electrified more or less. The pyro-electricity thus generated in the glass of the radiometer appears only in the interior, that without being dispersed in the air. The black vane-surfaces being more heated than the others, are more electrified, therefore more strongly repelled. If the radiometer is put in water, the glass is not heated and electrified, and there is no motion. If the reservoir is suspended by a thread, it turns inversely to the tourniquet, the action being equal and opposite. Starting with ordinary atmospheric pressure, the normal motion begins when the internal pressure is sufficiently diminished for the electrification by heat to be liberated. It ceases when the vacuum becomes so perfect that the electric spark cannot pass; for then the necessary reactions between tourniquet and envelope are not produced. The presence of some gas, then, is necessary as a vehicle of electricity, not as a mechanical propeller. The motion is faster the smaller the reservoir, the vanes being less distant from the electrified surface. Tourniquets of mica are more sensitive than those of aluminium, because crystalline surfaces liberate pyro-electricity much more easily than metallic substances covered more or less with an insulating coat.

No. 4: 22ND JANUARY.

Memoir on Electro-Capillary Actions. By M. BECQUEREL.

THE first subject treated is the depolarisation of the electrodes, (which must be as perfect as possible) and electric effects produced on contact of the skin with various liquids. Acids in contact with the skin take positive electricity, alkalies negative. With an alkaline liquid (as mono-sulphuret of sodium), the pores of the skin within the finger play the part of negative poles; those of the exterior are positive poles; the liquids within the finger tend to be deoxidised, those without to be oxidised. The opposite occurs with acids. In eggs, the white and yellow are separated by a membrane, and in incubation, the yellow tends to be reduced and the albumen oxidised. Soup and wine being positive, relatively to venous blood, and in contact with it in the stomach through the vessels, we have here two electro-capillary couples; liquids in the stomach are reduced, and the blood is oxidised. M. Becquerel studied the effect of an external current on electro-capillary currents. Where it went in the same direction with these, the deposit (of copper, *e.g.*) increased in the other case it diminished. Corresponding effects may depend on the direction of voltaic currents used in therapeutics. The author mentions some of the chemical actions of electro-capillary couples. In the second part of the memoir he compares the electro-motive forces produced on contact with water and sulphuric and nitric acids more or less hydrated, with the quantities of heat liberated under the same conditions. The greater hydration of the acid has always less influence on the electro-motive force than on the amount of heat liberated. There does not seem to be any relation between diffusion and the production of electro-motive force.

On the Transmission of Excitation in the Nerves of Sensibility. By M. BERT.

On the Characters of the Electric Discharges of the Torpedo. By M. MAREY.

APPLYING to the two faces of the electric organ two metallic plates connected with the wire of the electro-magnetic inscribing apparatus of M. Marcel Deprez, he provoked a discharge by exciting the animal. The instrument gave a strident sound indicating vibration, and a sinuous curve was found on the paper. Hence the discharge of the Torpedo is a complex act formed of successive currents which follow at very short intervals (one-sixtieth to one one-hundred and fortieth of a second in the cases referred to). This confirms suspected analogies between the electric act and the muscular act. M. Marey also demonstrates the gradual exhaustion of the torpedo-current, similar to that of the shocks of a muscle that is fatigued. Further, taking induced currents from the discharge of the torpedo, the signals made by inductor and induced are of the same number—showing a difference from the case of currents induced by

a battery, which occur both at opening and closing of the inducing circuit. It is to the currents induced at closing, that those induced by the torpedo-discharge correspond.

On the Return of the Contractility in a Muscle where this Property has Disappeared under the Influence of Strong Currents of Induction. By M. CARLET.

THE muscle will recover contractility under the application of a weaker current. Under the stronger, it has been subjected to excessive fatigue, and its chemical state is altered, so that contraction is become impossible. But the contractility has remained in a latent state; for the relative repose allowed by the weaker current allows nutrition to exercise its reparative action. This goes on increasing till the fatigue from the work of the muscle predominates over the reparative effect; then the amplitude of the jerks diminishes.

No. 5: 29TH JANUARY.

Report on a Memoir of M. Henri Becquerel, entitled "Experimental Researches on Magnetic Rotatory Polarisation."

On a new Arrangement of the Rods of Lightning-Conductors. By M. JARRIANT.

THE object is to diminish the weight and strain, also expense. Four corner channels of iron are arranged to form a quadrangular pyramid. They are supported at intervals by square pieces of iron, to which they are screwed, and are connected at the base by a cast-iron socket, with feet by which the rod is fixed to the wood-work. At their upper part they are brought to the diameter of 2cm., prescribed for the size of the copper point; and this is screwed on an iron rod, which traverses the system from top to bottom, and ensures metallic communication between all the parts composing it. Such a system weighs only 20 kilogs. (as against 120 k.), and its price is only half that of the rods hitherto employed (which is 300 francs).

On the Effects produced by Introduction of Foreign Bodies into Carbon, in the Preparation of Carbons for the Electric Light. By M. GAUDUIN.

A resumé (suggested by M. Archereau's mixture of carbon with magnesia) of experiments made with various mixtures in 1875. 1. Phosphate of lime from bones. This is decomposed, and the reduced calcium goes to the negative carbon (below), burning in air with a reddish flame. The lime and phosphoric acid expand in the air with abundant smoke. The light is double that from ordinary retort carbon-points. 2. Chloride of calcium, and borate and silicate of lime are likewise decomposed, but the boric and silicic acids seem to escape, by volatilisation, the action of the electricity. These bodies give less light than phosphate of lime. 3. Silica diminishes the light, fuses, and is volatilised without being decomposed. 4. Magnesia and borate and phosphate of magnesia give effects corresponding to those with phosphate of lime: but the flame is white, and the light less than with salts of lime. 5. Alumina and silicate of alumina are decomposed only with a very strong current and voltaic arc; the aluminium in vapour then comes from the negative pole like a jet of gas, and burns with a bluish, little-luminous flame. The flame and smoke accompanying these experiments seemed a great obstacle to their utilisation for lighting purposes. But it is a good way of studying the action of electricity on various bodies.

POGGENDORFF'S ANNALEN DER PHYSIK UND CHEMIE. No. 9: 1876.

Observation of the Retardation in the Flow of Induction Currents, by means of the Tuning-Fork Apparatus. By M. v. ETTINGSHAUSEN.

THE retardation referred to is that due to magnetic action and demagnetisation of the iron core. (The paper requires its accompanying figures, in order to be properly comprehended.)

On the Passage of Strong Induction Currents through Liquids. By M. HERWIG.—Reserved for separate notice.

Contributions to Electro-Dynamics. By M. WAND. HE first endeavours to show that according to Weber's law (for the force between electric particles), any electro-motive forces may arise out of the condition of equilibrium; it is therefore untrue to nature. Next, he points out some difficulties of Helmholtz's law of potential when applied to rotation-phenomena and electro-motive actions; it is especially shaken by Helmholtz's own experiment, showing that even without a gliding part in a conductor, which rotates in the neighbourhood of a magnet, an electro-motive force acts. M. Wand offers an elementary law of his own, as solving the difficulties.

No. 10.

The Electric Conductivity of Chlorhydric, Hydrochloric, Hydrobromic, and Hydriodic Acid, and of Sulphuric, Phosphoric, Oxalic, Pyrotartaric, and Acetic Acid, in Aqueous Solutions. By M. KOHLRAUSCH.

THE experiments with sulphuric and acetic acid seem to prove that a liquid consisting of only one chemically firm compound offers always a great resistance; and it is only after mixture with other liquids—*e.g.*, water, that a good conductor is produced. Concentrated acetic acid is a non-conductor of the rank of ether; concentrated sulphuric acid conducts at least twelve times worse than has hitherto been supposed. By mixture with water (which is also a bad conductor), we have a liquid which conducts up to 10,000 times better than the separate constituents. As soon, however, as the constituents stand in such a relation to each other that they enter into chemical combination, this has an injurious influence on the conductivity. The group of monobasic inorganic acids furnishes an interesting result in the agreement of the conductivity of solutions which have an equal number of molecules. The author is led by his own and previous researches to a comprehensive expression for the conductivity of many dilute aqueous solutions.

On the Number of Electric Materials. By M. NEUMANN.

"IF the supposition be correct, that the actions of of the electric current are to be ascribed to some materials which flow with certain velocities in the circuit, then we must, if we would avoid an open conflict with experimental facts, suppose at least *two* such materials."